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Riparian Obligate Nesting Success as Related to Cowbird Abundance and Vegetation Characteristics Along the Middle Rio Grande, New Mexico

U.S. Department of the Interior
Bureau of Reclamation
Ecological Planning and Assessment
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Executive Summary

The Bureau of Reclamation (Reclamation) has conducted several studies along the Rio Grande in order to investigate the relationship between Brown-headed Cowbirds (*Molothrus ater*) (cowbird), nesting Neotropical migrants, and their habitat. Concern over levels of parasitism experienced by the Middle Rio Grande population of the endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (SWFL) prompted a cowbird trapping program and the subsequent studies.

Reclamation initiated a nest monitoring study in 1999 to explore Neotropical migrant bird nesting along the Middle Rio Grande and to assess the effectiveness of the cowbird trapping program at reducing parasitism rates and improving nest success. Study plots were established within three different study reaches: (1) Elephant Butte project lands, (2) San Acacia, and (3) Bosque del Apache. A host of riparian obligate avian species was targeted in the nest monitoring study. Vegetation data were gathered within each study reach during the 1999 and 2000 field seasons to determine differences between the study reaches. In conjunction, point counts were conducted in four study reaches to: (1) evaluate the response of the local cowbird population to the removal efforts, (2) determine the association of cowbirds and range cattle, and (3) to quantify the songbird community for comparison among study sites.

During the 6-year nest monitoring study, 375 nests of Neotropical migrant riparian obligate songbirds were monitored. Success, predation, and parasitism rates ranged widely at individual sites between years and during individual years between sites, with the Elephant Butte reach being the most successful. Parasitism rates were, on average, slightly lower during trapping years than post-trapping years. However, nest success did not show a corresponding increase. Vegetation data gathered revealed that the Elephant Butte reach has the most dense, mature native vegetation of all the study reaches and that the San Acacia reach holds the youngest, least dense vegetation. Lastly, point count data collected during the study showed, for the most part, that the Bosque del Apache and Sevilleta reaches had the highest densities of cowbirds. Additionally, during years in which trapping occurred, cowbird densities on average were lower in the trapped reach than in the untrapped reaches. However, when comparing between-years data, cowbird densities were only lower in the Elephant Butte reach approximately half the time.

When considering all these data together, it appears that habitat quality is the most important factor to Neotropical migrant nesting success on the Middle Rio Grande. Cowbird parasitism plays a relatively minor role. When parasitism rates were locally reduced, compensatory factors seemed to make up for the reduction in parasitism, and nesting success did not significantly increase. Thus, cowbird trapping does not positively impact nesting Neotropical migrants, including the SWFL, on the Middle Rio Grande.

Introduction

Background

Since 1995, the Bureau of Reclamation (Reclamation) has conducted presence/absence surveys to determine the occurrence of Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (SWFL) territories in the Middle Rio Grande. The SWFL is an insectivorous, Neotropical migrant that breeds in dense riparian habitats near surface water or saturated soils in the Southwestern United States. Recent studies indicate that SWFL populations have declined across their range (USFWS 2002). The primary causes of declining populations are likely habitat loss or modification and brood parasitism by the Brown-headed Cowbird (*Molothrus ater*) (cowbird) (USFWS 2002). The U.S. Fish and Wildlife Service (USFWS) officially listed the Southwestern Willow Flycatcher as an endangered subspecies in February 1995 (60 FR 10694). The SWFL is also listed as endangered or a species of concern by the states of Arizona, California, Colorado, New Mexico, Utah, and Texas (Sogge et. al. 1997, TPWD 2005).

In 1995, SWFL nest monitoring performed in the Middle Rio Grande by the New Mexico Natural Heritage Program (NMNHP) indicated that parasitism by cowbirds may be a factor in the abandonment and/or failure of SWFL nests (five of seven nests were parasitized) (NMNHP 1995). The cowbird is an obligate brood parasite known to parasitize over 220 different avian species (Friedmann and Kiff 1985). Some larger host species [e.g., Red-Winged Blackbirds (*Agelaius phoeniceus*)] are capable of raising their own young and young cowbirds. However, smaller host species, like the SWFL, are usually unable to raise both their own young and cowbird young, and nests subsequently fail to fledge host young. Under consultation with the USFWS, a cowbird trapping program was initiated in 1996 by Reclamation as an effort to reduce the rate of brood parasitism experienced by the endangered SWFL within Elephant Butte project lands. Cowbird trapping continued on an annual basis until 2002.

In 1999, a nest monitoring study [loosely based on the Breeding Biology, Reproduction, and Monitoring Database (BBIRD) protocol - Martin et al. 1997] was established within three reaches of the Rio Grande (San Acacia, Bosque del Apache, and Elephant Butte project lands) to evaluate the effectiveness of the control program at reducing levels of brood parasitism and increasing nesting success. Due to the small sample of SWFL nests, a group of seven similar Neotropical migrant songbird species was selected to assess various nesting parameters. Species were selected based on their size, breeding period, nest defense ability, habitat requirements, and susceptibility to parasitism.

In conjunction with the nest monitoring study, avian point counts were conducted in both trapped and untrapped areas. The comparison of point count results is used as an estimate of the effectiveness of the cowbird trapping program at reducing the local

population of cowbirds, and to develop a better understanding of the distribution and abundance of cowbirds in relation to potential hosts and livestock within the riparian corridor. Lastly, coincidental with the establishment of the nest monitoring study, a vegetation study was performed in selected nest study plots. These data were gathered to assess vegetation characteristics within and between different study reaches in relation to nesting parameters observed in each reach.

Objectives

This report reviews nest monitoring, point count, and vegetation data gathered over the previous six seasons in order to determine:

1. The relationship between the distribution and abundance of cowbirds and range cattle within the Middle Rio Grande.
2. Whether cowbird trapping within the Middle Rio Grande has a positive effect on parasitism rates and nest success rates of Neotropical migrant species.
3. Whether habitat variables such as species composition, tree density, and concealment greatly effect nesting variables such as predation, parasitism, and nest success in the Middle Rio Grande.

Methods

Study Area

The study area encompassed the Rio Grande flood plain from the Sevilleta National Wildlife Refuge (NWR) to the delta of Elephant Butte Reservoir in central New Mexico (Figure 1). The study area was divided into four river reaches (Figure 2). Although the reaches are nearly contiguous, each reach is distinct, to varying degrees, regarding grazing, vegetation, hydrology, and land management objectives.

- The Sevilleta reach consists of the active flood plain within the Sevilleta NWR and extends approximately 6 kilometers (km) upstream of San Acacia Diversion Dam. The Sevilleta reach does not permit livestock grazing. This reach seldom experiences overbank flooding and is managed by the USFWS. Due to limited hydrology, native vegetation in this reach is limited to high flow channels, lower terraces, and riverbars where the native vegetation can outcompete saltcedar (*Tamarix* spp.) and Russian olive (*Eleagnus angustifolia*). The majority of vegetation in this reach is mid-aged to mature stands of saltcedar and Russian olive. Cowbird control (trapping) and nest monitoring plots are not present within this reach, however, point counts have been conducted here since 1999.

Figure 1. Study area.

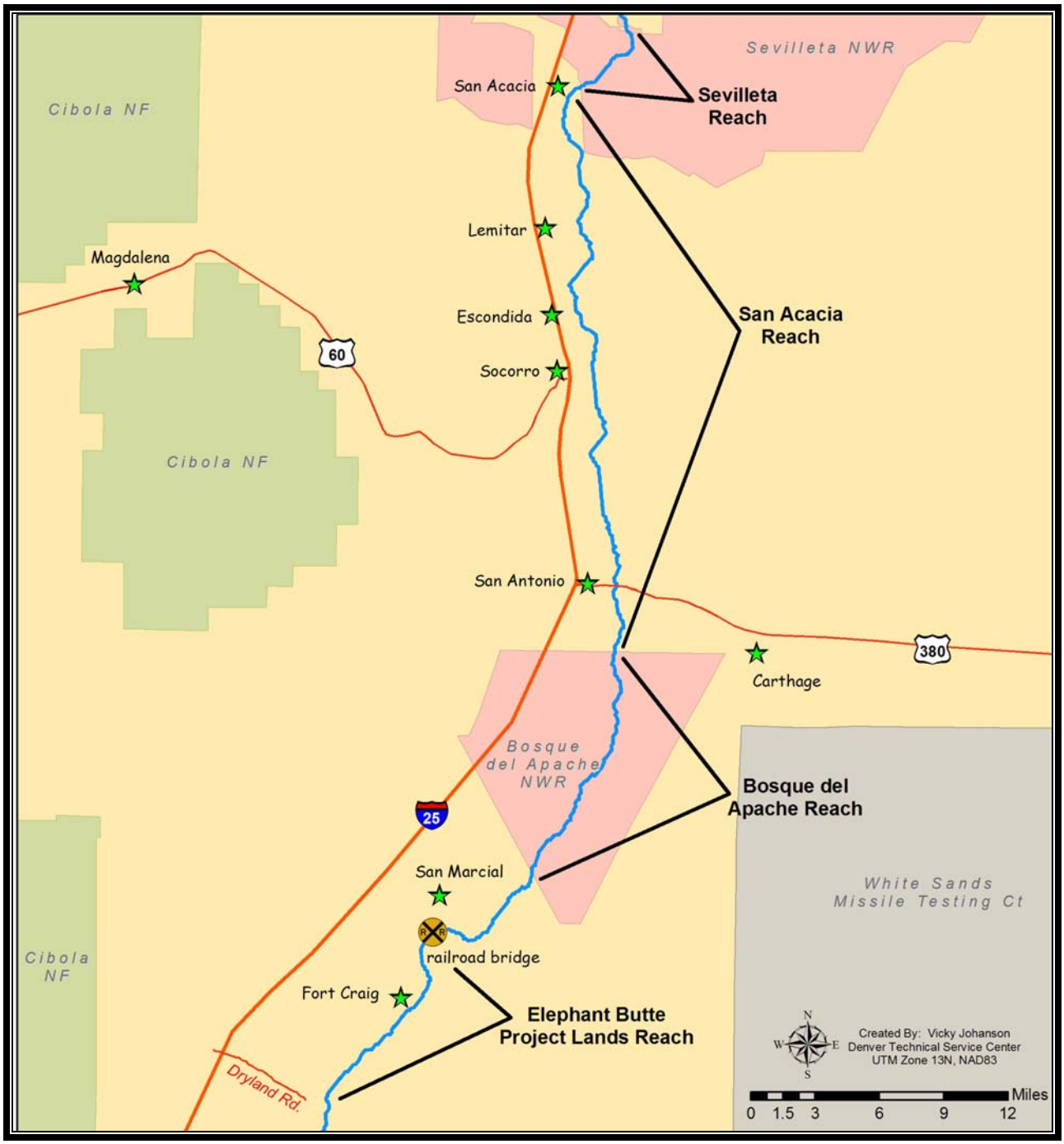

Figure 2. Four river reaches within study area.

- The San Acacia reach extends downstream from San Acacia Diversion Dam to the north boundary of the Bosque del Apache NWR. Portions of this reach are privately owned and managed. The Middle Rio Grande Conservancy District also manages some of these lands. Livestock grazing occurs within and/or adjacent to this reach throughout the year. This reach lies in close proximity to adjacent irrigated livestock pastures and hayfields. Much of the riparian area is not subject to frequent overbank flooding, due to the degraded river channel and incised banks. The majority of vegetation within this reach is exotic. Large stands of saltcedar and Russian olive are found throughout this reach. Densities range from extremely dense and decadent to very sparse. There are occasional stands of gallery cottonwoods (*Populus deltoides*) and a few patches of native willows (*Salix* spp.) near the river. This reach contains nest monitoring plots, but is not subject to cowbird trapping. Point counts have been conducted here since 1998.

- The Bosque del Apache reach consists of the Rio Grande corridor within the Bosque del Apache NWR. Livestock grazing is not permitted within the refuge boundaries, although occasional trespass cattle do occur. An extensive network of canals, laterals, and drains allows Bosque del Apache NWR personnel to actively manage water resources. Moist soil management units and cultivated food plots are utilized within the refuge to create and enhance waterfowl wintering habitat. In conjunction with the management of waterfowl wintering habitat, the Bosque del Apache NWR has developed extensive stands of dense native riparian habitat utilized by an abundance of Neotropical migrant songbirds. Within the active flood plain, native vegetation is limited to isolated patches on riverbars and depressions where hydrology is suitable. Saltcedar is the dominant species. This reach contains nest monitoring plots, but is not subject to cowbird trapping. Point counts have been conducted here since 1998.

- The Elephant Butte project lands reach extends downstream from its northern boundary (San Marcial railroad trestle) to the delta of Elephant Butte Reservoir. These lands were seasonally grazed from August 1 through April 15 during the 1997 and 1998 seasons. Livestock grazing was temporarily suspended from April 15, 1999, to October 15, 1999; however, trespass cattle were observed on numerous occasions. Grazing was resumed on a seasonal basis from August 1 to May 6 in 2000. Livestock grazing is not permitted during the SWFL breeding season, which was concurrent with the cowbird trapping period. In addition to livestock grazing, these project lands provide a wide range of recreational opportunities—boating, camping, fishing, and hunting. In high-water years, this reach experiences frequent overbank flooding. Thus, riparian vegetation within this reach, particularly within the active pool of Elephant Butte Reservoir, is the most extensive of any habitat within the study area. Goodding's willow (*Salix gooddingii)* is more prevalent in this reach than in any other, and the majority of this reach is dominated by fairly dense, large stands of mid-aged trees 10- to 20-centimeters (cm) in diameter at breast height (DBH). Cowbird trapping was initiated in 1996; traps were placed both within Elephant Butte project lands and adjacent private lands. Between 1997 and 2001, cowbird trapping was conducted within Elephant Butte project lands. Point counts

have been conducted within this site since 1997, and nest monitoring plots have been established since 1999.

Neotropical Migrant Songbird Nest Monitoring

In an effort to assess the rate of cowbird parasitism within the local songbird community and to evaluate the effectiveness of the cowbird trapping program, nest monitoring of Neotropical migrant songbirds was conducted in several nest plots within each study reach during the avian breeding season (late May to early August). In 1999, nest monitoring plots were established within the riparian community on the San Acacia, Bosque del Apache, and Elephant Butte project lands study area. Four plots (San Acacia Plots 1-4, Bosque Plots 1-4, and Elephant Butte Plots 1-4) were initially established in each study reach, ranging in size from 2 to 6 hectares (ha). However in 2000, due to logistical constraints, one plot was eliminated from each study reach (San Acacia Plot 2, Bosque Plot 4, and Elephant Butte Plot 1). All plots were non-randomly located in large patches of native-dominated vegetation. All attempts were made to locate plots in habitat of similar height and density. However, due to the limited extent of native habitat within the active flood plain in the San Acacia and Bosque del Apache reaches, this was not possible. Due to time and budgetary constraints, nest monitoring plots were not established in the Sevilleta reach. For maps of all nest monitoring plots showing habitat classes, see Appendix.

In order to obtain a statistically valid sample size, a group of seven similar riparian obligate Neotropical species was selected for comparison. Species include: Bell's Vireo (*Vireo bellii*), Black-headed Grosbeak (*Pheucticus melanocephalus*), Blue Grosbeak (*Guiraca caerulea*), Common Yellowthroat (*Geothlypis trichas*), Red-winged Blackbird, Spotted Towhee (*Pipilo maculatus*), and Yellow-breasted Chat (*Icteria virens*). These species were selected because they are similarly sized riparian-obligate species which build open-cup nests usually less than 5 meters (m) off the ground.

Nest monitoring was performed as outlined in the BBIRD protocol (Martin et al. 1997). The presence of at least one cowbird egg or cowbird chick indicated the nest had been parasitized. All data—location, nest substrate, nest height, dates of nest chronology, clutch size, parasitism, success, and productivity—were recorded on the appropriate field forms and later entered into computer spreadsheets for analysis. A nest was considered to have failed if it did not fledge any host young.

Habitat Analysis

The nest plot vegetation study conducted in 1999 and 2000 began as a pilot study developed by Reclamation, the NMNHP, and the University of New Mexico to determine a standard vegetation monitoring protocol for the Middle Rio Grande. Fifteen vegetation quadrats, each 5 m^2, were located within each nest monitoring plot chosen for vegetation analysis (Figure 3). Each nest monitoring plot was divided into three zones of

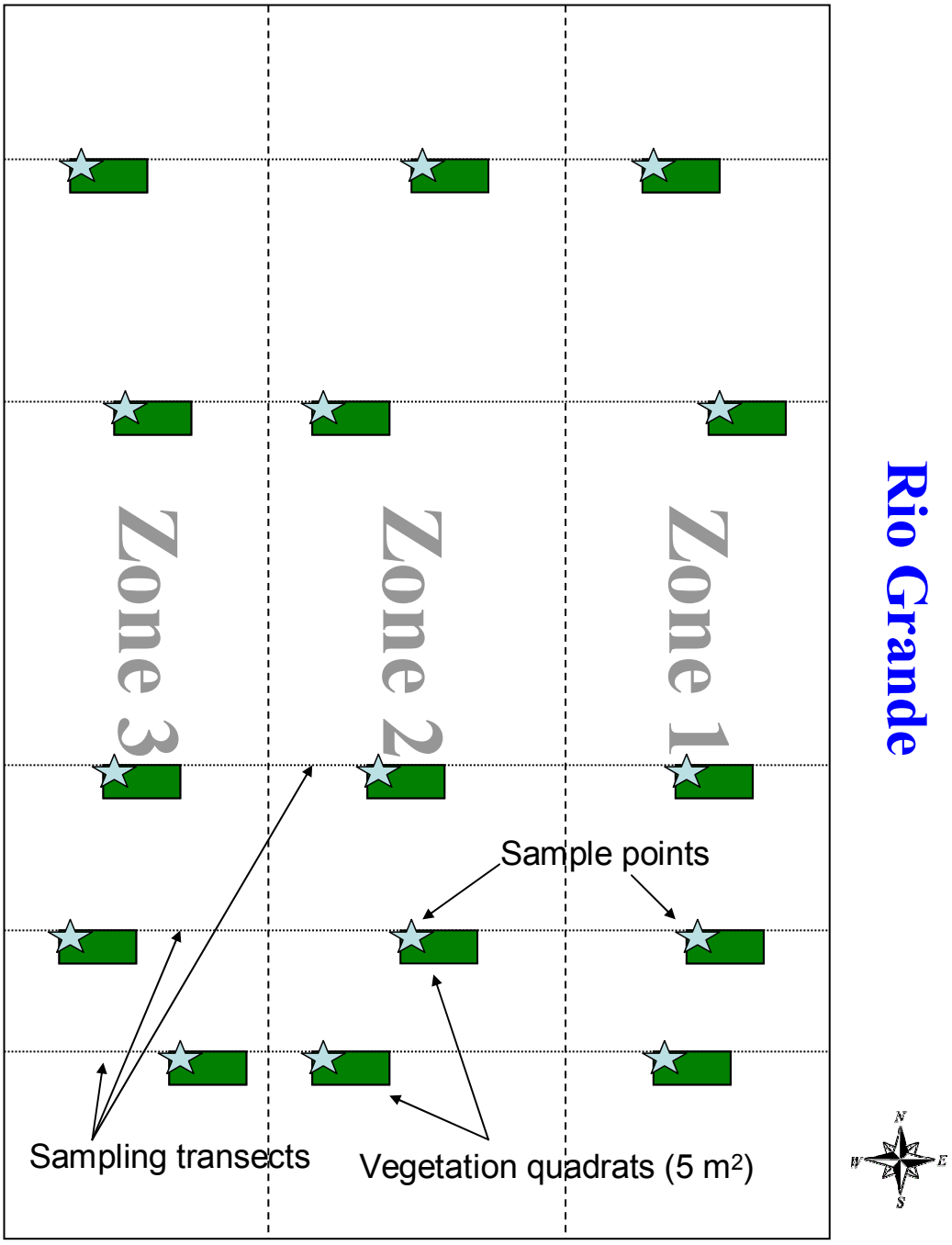

Figure 3. Layout of vegetation sample points and quadrats within nest monitoring plots (not to scale). Zones were between 20 and 65 m wide, depending on width of flood plain and nest monitoring plot. Transects and sample points were located randomly. Sample points were northwest corner of quadrats.

equal width between 20 and 65 m wide, depending on nest plot width, to minimize the effects of proximity to the Rio Grande. Five randomly located transects were then located perpendicular to the three zones. A sample point was then randomly located

within each zone along the five transects. Lastly, a vegetation quadrat was located at the sample point with the sample point always being the northwest corner of the quadrat. Due to research priorities and budgetary constraints, one nest monitoring plot within the San Acacia reach (San Acacia Plot 1), one within the Bosque del Apache reach (Bosque Plot 2), and three within the Elephant Butte reach were analyzed (Elephant Butte Plots 2, 3, and 4).

Data gathered at each sample point included tree (≥ 5 cm) diameter at DBH and shrub (< 5 cm) DBH species abundance by height and DBH class, percent herbaceous ground cover, point-centered quarter measurements, and percent concealment using a cover pole (Figure 4). Shrub data were gathered by counting and measuring individual shrub stems within the 5-m^2 quadrat. Tree data were gathered using the point-centered quarter method (Elzinga et al. 1998), measuring the distance to the nearest tree in each quarter and recording its species, height, and DBH. Concealment data were gathered using a telescopic concealment pole with a 3-ft section at the top divided into tenths. The pole was raised to each respective height and the number of one-tenth sections obscured was observed by an individual standing 5 m from the pole at both 0 degrees and 180 degrees from the pole. This was repeated three times at different points on the perimeter of each quadrat. Lastly, ocular estimations were made of vegetative ground cover and litter within each quadrat. These data were used to compute shrub and tree stem densities by species, percent composition by species, percent composition by height and DBH class per species, percent concealment by height class, and average vegetative and litter ground cover.

Cowbird Trapping

Approximately 15 traps were deployed in the trapping area between 1997 and 2001. Trap design was based on the Australian crow trap (TPWD n.d.). This trap design is effective for capturing granivorous, gregarious birds of varying size. Trap site selection was determined based on SWFL territory locations and annual trapping results. Other sites were selected near suitable cowbird feeding areas. The cowbird trapping program is discussed in detail in *Brown-Headed Cowbird Control – Middle Rio Grande, New Mexico – 2001 Study Results* (Bureau of Reclamation 2002).

Neotropical Migrant Songbird Point Counts

Songbird point counts were conducted to monitor the distribution and abundance of cowbirds and host species within the riparian study area. Between 1999 and 2002, each of the four river reaches was surveyed an average of five times per year. In 2003 and 2004, three point counts were performed in each reach to coincide with the resident cowbird period. For each point count route the mean per point and frequency of cowbirds and the seven host species were determined. These data were then used to assess the effectiveness of the cowbird trapping program at reducing cowbird abundance

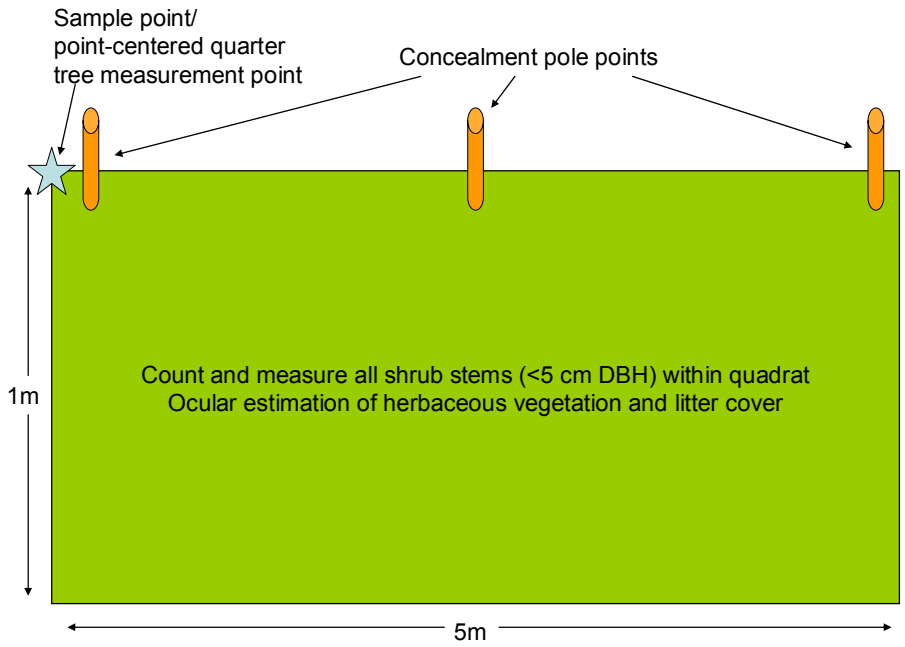

Figure 4. Vegetation study quadrat showing dimensions and location of various habitat parameter measurements.

in the trapping area and to explore the relationship of range cattle and cowbirds. Point count methodology is discussed in detail in *An Assessment of the Brown-Headed Cowbird Control Program in the Middle Rio Grande, New Mexico* (Moore and Ahlers 2003).

Results and Discussion

The decline of many Neotropical migrant birds, including the SWFL, can be partially attributed to brood parasitism by the cowbird (Sogge et al. 1997; USFWS 2002). Localized trapping efforts centered near nesting areas of endangered host species such as the SWFL and Least Bell's Vireo have been known to reduce parasitism and increase host nest success (Griffith and Griffith 1993; Whitfield and Placer 1994; Whitfield and Strong 1995). The following sections present and discuss results of the various studies performed by Reclamation in the Middle Rio Grande related to the issues of cowbird parasitism and Neotropical migrant nesting.

Neotropical Migrant Songbird Nest Monitoring

Table 1 summarizes nest monitoring data for the years 1999 to 2004. During this period, 375 nests were monitored. Parasitism, nest success, and predation rates were highly variable.

Table 1. Summary of Neotropical migrant nest monitoring data - 1999 to 2004

	Elephant Butte (cowbird trapping area from 1999-2001 – seasonally grazed)						San Acacia (grazed)					
	Trapping			No trapping			No trapping					
	1999	2000	2001		2003	2004	1999	2000	2001	2002	2003	2004
Parasitism Level	13% (2/16)	25% (7/28)	35% (6/17)	31% (9/29)	47% (14/30)	44% (4/9)	50% (10/20)	70% (16/23)	65% (15/23)	57% (20/35)	40% (4/10)	40% (6/15)
Nest Success	38% (6/16)	64% (18/28)	59% (10/17)	52% (15/29)	27% (8/30)	56% (5/9)	35% (7/20)	52% (12/23)	39% (9/23)	29% (10/35)	10% (1/10)	20% (3/15)
Nest Predation	19% (3/16)	18% (5/28)	24% (4/17)	28% (8/29)	33% (10/30)	22% (2/9)	55% (11/20)	43% (10/23)	13% (3/23)	43% (15/35)	60% (6/10)	60% (9/15)

	Bosque del Apache (ungrazed)					
	No trapping					
	1999	2000	2001	2002	2003	2004
Parasitism Level	15% (4/27)	64% (18/28)	52% (14/27)	21% (5/24)	89% (8/9)	40% (2/5)
Nest Success	44% (12/27)	39% (11/28)	41% (11/27)	21% (5/24)	22% (2/9)	60% (3/5)
Nest Predation	48% (13/27)	46% (13/28)	19% (5/27)	63% (15/24)	33% (3/9)	20% (1/5)

+ Values in this table illustrate nest plot nest monitoring of riparian obligate cowbird host species: Bell's Vireo, Black-Headed Grosbeak, Blue Grosbeak, Common Yellowthroat, Red-Winged Blackbird, Spotted Towhee, and Yellow-Breasted Chat.

Variation is likely due to a variety of factors including habitat and hydrology (discussed later) that vary within each nest monitoring plot. These 6 years of data have provided insight into overall trends of the three reaches. These data suggest that parasitism rates during trapping years were slightly lower in the Elephant Butte reach than in the other two study reaches and that nest success rates did not differ markedly.

An ANOVA showed that there was an equal distribution of nests of the seven target species within each study reach ($P = 0.96$, $Df = 2$, $F\text{-ratio} = 0.04$). Data sets from the Bosque del Apache reach in 2003 and 2004 and the Elephant Butte reach in 2004 were too small for statistical analysis. However, statistical analysis of the other data sets showed that parasitism rates between trapped and untrapped reaches within years were lower in half of the comparisons (Table 2). These differences were likely due to higher parasitism rates in the untrapped reaches as opposed to a reduction from trapping in the Elephant Butte reach. However, nest success rates between trapped and untrapped reaches did not show an equivalent increase. The only difference between a trapped and untrapped reach occurred in the absence of trapping (Table 2). Additionally, when comparing parasitism and nest success data from years when trapping occurred in the Elephant Butte reach to years when it did not occur (Table 3), there are only 2 statistically significant differences out of 12 comparisons. These data show that, although cowbird trapping may reduce parasitism rates locally, there is no apparent corresponding increase in nesting success.

Table 2. Comparison of Elephant Butte reach parasitism and nest success rates and those of the San Acacia and Bosque del Apache reaches (1999 - 2004) during trapping (1999 – 2001) and non-trapping (2002 – 2004) years

		Parasitism rates		**Success rates**	
		Elephant Butte vs. San Acacia	**Elephant Butte vs. Bosque del Apache**	**Elephant Butte vs. San Acacia**	**Elephant Butte vs. Bosque del Apache**
Trapping	**1999**	EB < SA P = 0.044	SAME P = 1.000	SAME P = 1.000	SAME P = 0.899
	2000	EB < SA P = 0.004	EB < BDA P = 0.007	SAME P = 0.556	SAME P = 0.109
	2001	SAME P = 0.120	SAME P = 0.445	SAME P = 0.361	SAME P = 0.390
No Trapping	**2002**	SAME P = 0.066	SAME P = 0.599	SAME P = 0.103	EB > BDA P = 0.043
	2003	SAME P = 1.000	N/A	SAME P = 0.512	N/A
	2004	N/A	N/A	N/A	N/A

$\alpha = 0.05$
The Chi-square test with Yates correction was used for statistical analysis.
N/A = Insufficient data for comparison

Table 3. Comparison of Elephant Butte reach parasitism and nest success rates during trapping (1999 – 2001) and non-trapping (2002 – 2004) years

	Elephant Butte parasitism rates	Elephant Butte nest success rates
1999 vs. 2002	SAME P = 0.306	SAME P = 0.546
2000 vs. 2002	SAME P = 0.832	SAME P = 0.489
2001 vs. 2002	SAME P = 1.000	SAME P = 0.873
1999 vs. 2003	99 < 03 P = 0.046	SAME P = 0.672
2000 vs. 2003	SAME P = 0.149	00 > 03 P = 0.009
2001 vs. 2003	SAME P = 0.652	SAME P = 0.062
1999 vs. 2004	N/A	N/A
2000 vs. 2004	N/A	N/A
2001 vs. 2004	N/A	N/A

α = 0.05
The Chi-square test with Yates correction was used for statistical analysis.
N/A = Insufficient data for comparison

Vegetation Analysis

Numerous habitat variables were considered during the vegetation studies performed in 1999 and 2000. For the purpose of this assessment, we analyzed variables that could influence the rates of parasitism, predation, and nest success within the different study reaches. These variables include native, exotic, and total shrub (< 5-cm DBH) densities, tree (≥ 5-cm DBH) density, tree species composition, and percent concealment by height class. Overall shrub densities were lowest in the Elephant Butte reach (9.9/m^2, n = 45) and highest in the San Acacia reach (39.7/m^2, n = 15). Native species composed a majority of the shrub stems in all three study reaches. An ANOVA was performed on the three different groups of data (natives, exotics, and total), and showed that total and exotic shrub densities were significantly greater in the San Acacia reach than in the Bosque del Apache and Elephant Butte reaches ($P < 0.01$, Df = 2, F-ratio = 28.8 and $P = 0.02$, Df = 2, F-ratio = 4.4, respectively). Native shrub densities varied significantly within each reach ($P < 0.01$, Df = 2, F-ratio = 25.1), with Elephant Butte being lowest, Bosque del Apache being middle, and San Acacia being highest in native shrub density. See Table 4 for detailed shrub count data.

Table 4. Native, exotic, and total shrub (< 5-cm) DBH stem densities within nest monitoring study plots

	Mean (ind/m^2)	Variance
Native Species (Cottonwood – *Populus deltoids* ssp. *wislizeni*, coyote willow – *Salix exigua*, Goodding's willow, seep willow – *Baccharis* sp.)		
San Acacia	31.4	519.4
Bosque del Apache	14.4	109.4
Elephant Butte	6.7	23.4
Exotic Species (Saltcedar, Russian olive)		
San Acacia	8.3	70.4
Bosque del Apache	0.7	1.0
Elephant Butte	3.1	64.2
All Species		
San Acacia	39.7	533.7
Bosque del Apache	15.1	104.7
Elephant Butte	9.9	82.7

A point-centered quarter measurement was used to estimate tree density within the nest monitoring plots. Species documented were the same as those in the shrub counts, with the exception of seep willow. Due to logistic constraints while recording these data, only trees within 25 m of the sample point were recorded. An ANOVA ($P < 0.01$, $Df = 2$, F-ratio = 7.03) indicated that tree density within the Elephant Butte reach was significantly greater than that documented in both the San Acacia and Bosque del Apache reaches (Table 5). Although an effort was made to locate all nest monitoring plots in primarily native habitat, species composition was also significantly different within the various reaches. The percentage of native trees (Table 5) was significantly greater in the Elephant Butte reach than in the San Acacia reach ($\chi^2=46.8$, $Df = 1$, $P < 0.01$) and the Bosque del Apache reach ($\chi^2=19.9$, $Df = 1$, $P < 0.01$). The percentage of native trees was also significantly higher in the Bosque del Apache reach than in the San Acacia reach ($\chi^2=5.27$, $Df = 1$, $P = 0.02$).

Table 5. Tree stem data from point-centered quarter measurements within nest monitoring plots

	Tree Density	Percent Native
San Acacia	78.8/ha (n = 13)	21.9% (n = 31)
Bosque del Apache	176.9/ha (n = 15)	51.0% (n = 49)
Elephant Butte	1732.8/ha (n = 45)	83.1% (n = 172)

Shrub and tree data, considered together, illustrate a marked difference between the study reaches. The San Acacia reach is composed of a relatively dense shrub layer with sparse trees. This reach also contains the highest abundance of exotic shrubs and the greatest percentage of exotic trees. The Bosque del Apache reach falls in between the other two reaches in terms of shrub and tree densities. It contains a much greater percentage of native shrubs than the San Acacia reach but is much lower in tree density than the Elephant Butte reach. The Elephant Butte reach is the most mature of the three study

reaches. Very few shrub-sized woody species exist in this reach, due to the high density of trees.

The last habitat variable considered in this assessment, and the variable potentially most influential to cowbird parasitism and nest success rates, is vegetative concealment at various height levels. Four different height intervals were examined in the three different nest study reaches: 3 to 6 ft, 6 to 9 ft, 9 to 12 ft, and 12 to 24 ft. Mature vegetation found in the Elephant Butte reach provided much greater concealment at the upper layers than the habitat in the San Acacia and Bosque del Apache reaches (Table 6).

Table 6. Concealment values and ANOVA results for the three nest plot study reaches

Vegetation layer	San Acacia (n=15)	Bosque del Apache (n=15)	Elephant Butte (n=57)	ANOVA results
3 to 6 ft	57.2%	58.2%	57.0%	P = 0.98, Df = 2, F-ratio < 0.1
6 to 9 ft	30.3%	49.0%	62.1%	P < 0.01, Df = 2, F-ratio = 13.1
9 to 12 ft	17.0%	34.4%	64.0%	P < 0.01, Df = 2, F-ratio = 36.0
12 to 24 ft	7.1%	16.5%	63.9%	P <0.01, Df = 2, F-ratio = 75.0

With the exception of the 3- to 6-ft level, the Elephant Butte reach had significantly higher concealment values at all levels. Concealment within the Bosque del Apache reach was also significantly greater than in the San Acacia reach at the 6- to 9-ft and 9- to 12-ft layers. Thus, it can be inferred that the habitat in the Elephant Butte reach is taller and contains more vertical structure and would provide canopy nesting birds more protection from cowbirds and predators.

When this nest monitoring study began, we attempted to locate nest monitoring plots in similarly aged monotypic stands of native vegetation (primarily willows). This proved challenging as the majority of large, native patches of habitat in the San Acacia and Bosque del Apache reaches were young stands of coyote willow and cottonwood. Conversely, the majority of the native habitat in the Elephant Butte reach is more mature (10- to 20-cm DBH) Goodding's willow and cottonwood. After 6 years of nest monitoring, it is apparent that vegetation structure and density play an important role in nesting success.

During the 6-year nest monitoring study, the lowest predation and cowbird parasitism rates and the highest nest success rates were all documented in the Elephant Butte reach (Table 7). It is no coincidence that this reach also has the lowest shrub density, highest density of trees, the greatest percentage of native trees, and the highest vegetative concealment at the mid and upper levels of the canopy (Table 6). Alternatively, the San

Table 7. Selected nesting variables from three nest monitoring reaches in the Middle Rio Grande - 1999 to 2004

	Cowbird Parasitism	Nest Predation	Nest Success
San Acacia (n = 126)	56.3%	42.9%	33.3%
Bosque del Apache (n = 120)	42.5%	41.7%	36.7%
Elephant Butte (n = 120)	32.6%	24.8%	48.1%

Acacia reach exhibited the highest levels of predation and cowbird parasitism and the lowest nest success rates. This reach also has the highest shrub density, lowest density of trees, the lowest percentage of native trees, and the lowest vegetative concealment at the upper levels. The Bosque del Apache reach falls in between the other two reaches in terms of nesting and habitat variables.

Cowbird Trapping

A total of 4,739 cowbirds were captured during the 6 years of the trapping program. Table 8 presents the trapping dates, number of traps, and total number of cowbirds and resident cowbirds captured and removed within the Elephant Butte project lands reach between 1996 and 2001. Annually, the capture rate peaked during the week of northward migration (generally around mid- to late-May). The capture rate declined following the May peak until a second peak occurred during the southward migration in late July. Juveniles usually were first captured around the first of July. No trapping occurred between 2002 and 2004.

Table 8. Cowbirds captured and removed during the 6-year trapping program

Year	Trap dates	Number of traps	Trap days	Number of cowbirds captured	Non-migratory cowbirds captured
1996	6/4 - 7/29	5	275	1140	275
1997	4/22 - 8/26	15	1,905	615	246
1998	5/1 - 8/11	14	1,267	725	279
1999	5/1 - 8/11	15	1,353	846	213
2000	5/4 - 7/28	15	1,269	835	260
2001	5/5 - 7/31	15	1,170	578	275
Total			**7,239**	**4,739**	**1548**

During the 6 years of the trapping program, the annual variation in total number of cowbirds captured is quite large. However, when the resident period is considered, the number of cowbirds trapped becomes surprisingly similar between years (mean = 258, S.D. = 25.3). This suggests that recruitment and/or immigration of cowbirds on an

annual basis are sufficient to compensate for the approximately 250 individuals removed from the local area by annual trapping efforts.

Neotropical Migrant Songbird Point Counts

Table 9 illustrates point count data for each of the four study reaches in the study area during the 6 years of the nest monitoring study. For statistical analysis, only point counts conducted from May 20 to July 15 were used. Mean numbers of cowbirds were lowest in the Elephant Butte and San Acacia reaches and highest in the Sevilleta and Bosque del Apache reaches. The San Acacia reach is subject to year-round grazing and is in close proximity to irrigated pastures, hayfields, and other agricultural activities. Our data suggest that several factors, including host abundance and proximity to feeding areas and water, may have a greater influence on the distribution and abundance of cowbirds than the presence of livestock.

For cowbird and host abundance comparisons, data from six consecutive seasons of point counts were analyzed using the Mann-Whitney W-test. These interpretations of point count data (Table 9) are shown in Tables 10 and 11. Mean cowbird numbers for the resident period were compared between trapping and non-trapping years within sites (Table 10) and between trapped and untrapped sites during the trapping years (Table 11). In Table 10, yellow cells represent a significantly lower cowbird abundance during trapping years within the Elephant Butte reach. Blue cells highlight trapping years when cowbird abundance was significantly greater in the non-trapped reaches than during post-trapping years. Lastly, yellow cells in Table 11 show that the Elephant Butte reach had a lower abundance of cowbirds during the trapping years than the Bosque del Apache or Sevilleta reaches. These comparisons suggest that cowbird trapping had a significant impact on cowbird abundance within the study areas.

For comparison of potential cowbird host densities between the various study reaches, the same group of species used for the nest monitoring study was evaluated (Table 9). The mean number of hosts on the Sevilleta and Elephant Butte project lands reaches were the highest among the four sites. Host means were lowest within the San Acacia reach. Host species abundance within the Elephant Butte reach has steadily increased since the start of the study while the mean number of hosts within the other three reaches have remained relatively constant.

The last row of data from Table 9, the ratio of cowbird mean count to host mean count, is also interesting. These data, with and without cowbird trapping, remained relatively constant. During the 6 years of this study, the Elephant Butte reach had the lowest cowbird to host ratio, followed by the Sevilleta reach, and then by the San Acacia and Bosque del Apache reaches (which are approximately equal). Additionally, the Elephant Butte reach cowbird to host ratio has remained very stable during the 6 study years (Mean of means = 0.15, S.D. = 0.02) even though the overall mean number of hosts has increased greatly. This suggests that cowbirds recruit or immigrate as hosts and habitat become available. Also, cowbird numbers are not greatly reduced year to year by trapping.

Table 9. Point count results – Middle Rio Grande – 1999 – 2004

	Elephant Butte project land (cowbird trapping area from 1999-2001 - seasonally grazed)						San Acacia (grazed)					
	Trapping			No trapping			No trapping					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
Cowbird mean count	0.32 (s^2=0.42) n=100	0.59 (s^2=0.76) n=75	0.64 (s^2=0.88) n=75	0.60 (s^2=0.59) n=75	0.73 (s^2=1.52) n=75	1.60 (s^2=5.51) n=75	0.78 (s^2=1.35) n=140	0.79 (s^2=1.28) n=75	0.72 (s^2=0.74) n=75	0.81 (s^2=1.18) n=75	0.49 (s^2=0.74) n=75	0.94 (s^2=1.47) n=69
Host species mean count	2.47 (s^2=3.48) n=100	3.51 (s^2=3.79) n=75	4.53 (s^2=3.25) n=75	4.29 (s^2=3.56) n=75	6.08 (s^2=24.13) n=75	8.67 (s^2=48.31) n=75	1.43 (s^2=1.51) n=140	2.28 (s^2=2.58) n=75	2.00 (s^2=1.81) n=75	1.76 (s^2=3.24) n=75	1.33 (s^2=1.77) n=75	2.64 (s^2=3.76) n=69
Cowbird mean count/host mean count	0.13	0.17	0.14	0.14	0.12	0.18	0.55	0.35	0.36	0.46	0.37	0.36

	Bosque del Apache (ungrazed)						Sevilleta (ungrazed)					
	No trapping						No trapping					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
Cowbird mean count	1.00 (s^2=2.00) n=69	1.32 (s^2=1.17) n=75	1.15 (s^2=0.99) n=75	1.36 (s^2=3.23) n=75	0.52 (s^2=0.93) n=75	0.91 (s^2=2.65) n=75	1.48 (s^2=1.92) n=80	1.50 (s^2=1.34) n=60	1.58 (s^2=2.11) n=60	1.48 (s^2=1.51) n=60	1.00 (s^2=2.07) n=56	0.93 (s^2=1.79) n=60
Host species mean count	2.12 (s^2=1.63) n=69	3.16 (s^2=2.89) n=75	3.23 (s^2=3.18) n=75	2.73 (s^2=2.68) n=75	2.04 (s^2=2.20) n=75	2.85 (s^2=3.67) n=75	4.31 (s^2=3.76) n=80	5.10 (s^2=3.89) n=60	4.87 (s^2=4.02) n=60	4.08 (s^2=2.62) n=60	3.66 (s^2=4.56) n=56	3.72 (s^2=4.27) n=60
Cowbird mean count/host mean count	0.47	0.42	0.36	0.50	0.25	0.32	0.34	0.29	0.32	0.36	0.27	0.25

[1] Only point count data from resident Neotropical breeding period used (May 20 to July 15), all detections ≤ 50 m away were counted, variations in number of points per route (n) are due to unexpected weather (e.g., Bosque del Apache 1999) or more counts conducted during the resident period (e.g., Elephant Butte 1999, Sevilleta 1999).

[2] In calculating host mean values, detections from seven species were used. These included Bell's Vireo, Black-Headed Grosbeak, Blue Grosbeak, Common Yellowthroat, Red-Winged Blackbird, Spotted Towhee, and Yellow-Breasted Chat.

S^2 = Variance

Table 10. Statistical comparison of mean cowbird counts within individual reaches between trapping (1999-2001) and non-trapping (2002-2004) years

	Statistical comparison by year*								
	99 vs. 02	**99 vs. 03**	**99 vs. 04**	**00 vs. 02**	**00 vs. 03**	**00 vs. 04**	**01 vs. 02**	**01 vs. 03**	**01 vs. 04**
EB	99 < 02 P=0.002	99 < 03 P=0.020	99 < 04 P<0.001	00 = 02 P=0.611	00 = 03 P=0.933	00 < 04 P=0.015	01 = 02 P=0.720	01 = 03 P=0.988	01 < 04 P=0.019
SA	99 = 02 P=0.703	99 = 03 P=0.051	99 = 04 P=0.305	00 = 02 P=0.760	00 = 03 P=0.094	00 = 04 P=0.398	01 = 02 P=0.938	01 > 03 P=0.040	01 = 04 P=0.511
BDA	99 = 02 P=0.054	99 > 03 P=0.017	99 = 04 P=0.565	00 = 02 P=0.285	00 > 03 P<0.001	00 > 04 P<0.001	01 = 02 P=0.976	01 > 03 P<0.001	01 > 04 P=0.012
SEV	99 = 02 P=0.768	99 > 03 P=0.016	99 > 04 P=0.006	00 = 02 P=0.828	00 > 03 P=0.003	00 > 04 P=0.001	01 = 02 P=0.940	01 > 03 P=0.008	01 > 04 P=0.003

* Mann-Whitney W-test (α = 0.05)
Abbreviations: EB = Elephant Butte reach, SA = San Acacia reach, BDA = Bosque del Apache reach, SEV = Sevilleta reach
Yellow shading = lower BHCO abundance during trapping year, blue shading = higher BHCO abundance during trapping year

Table 11. Statistical comparison of mean cowbird counts during trapping years between trapped and untrapped reaches

	Statistical comparison by site*		
	EB vs. SA	EB vs. BDA	EB vs. SEV
1999	EB < SA P<0.001	EB < BDA P<0.001	EB < SEV P<0.001
2000	EB = SA P=0.409	EB < BDA P<0.001	EB < SEV P<0.001
2001	EB = SA P=0.337	EB < BDA P<0.001	EB < SEV P<0.001
2002	EB = SA P=0.467	EB < BDA P<0.001	EB < SEV P<0.001
2003	EB = SA P=0.349	EB = BDA P=0.495	EB = SEV P=0.136
2004	EB = SA P=0.331	EB = BDA P=0.142	EB = SEV P=0.202

* Mann-Whitney W-test (α = 0.05)
Abbreviations: EB = Elephant Butte reach, SA = San Acacia reach, BDA = Bosque del Apache reach, SEV = Sevilleta reach
Yellow shading = BHCO abundance lower in trapped reach than untrapped reach during trapping year

CONCLUSIONS AND RECOMMENDATIONS

The various aspects of the nest monitoring study outlined in this report provide insight into Neotropical migrant nesting in the Middle Rio Grande and can be used to assess the success of the cowbird trapping program. Several conclusions can be drawn based on the analyses of data gathered during these studies. Six years of nest monitoring data showed that the Elephant Butte reach had the lowest overall levels of cowbird parasitism and predation and the highest nest success (Table 7). This difference, particularly during the trapping period, could be attributed to the trapping and removal of cowbirds within this reach. However, after analysis of the data, it appears that cowbird trapping did little to reduce parasitism levels and did not increase nest success for the most part.

The vegetation study provided insight into some of the causes of the high degree of nesting variability between reaches. The Elephant Butte reach is dominated by more mature stands of native habitat interspersed with occasional openings and younger age classes of vegetation. This high quality native habitat provides the highest vegetative concealment values at the upper canopy levels. This reach also had the highest nest success among Neotropical migrants. The vertical structure of the vegetation in the Elephant Butte reach allows nesting birds to avoid predation and parasitism pressure by concealing their nests in the dense canopy.

Point count data indicated that cowbird trapping had a significant effect on the abundance of cowbirds in the local area. Also, point count data showed that cowbirds and their hosts are increasing in the Elephant Butte reach, while remaining relatively constant in the other three reaches. This is likely due to the high quality habitat expanding in this reach. Point counts also suggested there are other factors, including host abundance and proximity to feeding areas and water, that influence the distribution and abundance of cowbirds more than the presence of livestock.

Lastly, trapping data show that cowbird recruitment and immigration are sufficient to compensate for the removal of a portion of the local cowbird population.

In conclusion, based on several years of nest monitoring, vegetation, and point count data, habitat is the most important factor contributing to nest success, predation, and cowbird parasitism rates in our study area in the Middle Rio Grande. Cowbird trapping may reduce cowbird numbers and even parasitism rates in certain years, but trapping did not increase nest success for monitored Neotropical migrants, which is the true measure of a successful trapping program. We recommend that:

1. Other methods of alleviating cowbird parasitism pressure on special status species (e.g., SWFL), such as habitat improvement and BHCO egg removal/addling, should be explored if the need arises. No additional cowbird trapping should be done in the Middle Rio Grande for purposes of increasing nest success for special status

Neotropical migrants. The suspension of trapping in 2001 was justified based on these data.

2. Limited resources should focus on habitat management, restoration, and development, when feasible.
3. Cowbird distribution should not be considered an issue when formulating grazing regimes along the Middle Rio Grande as the cowbird/livestock association has been disproved.

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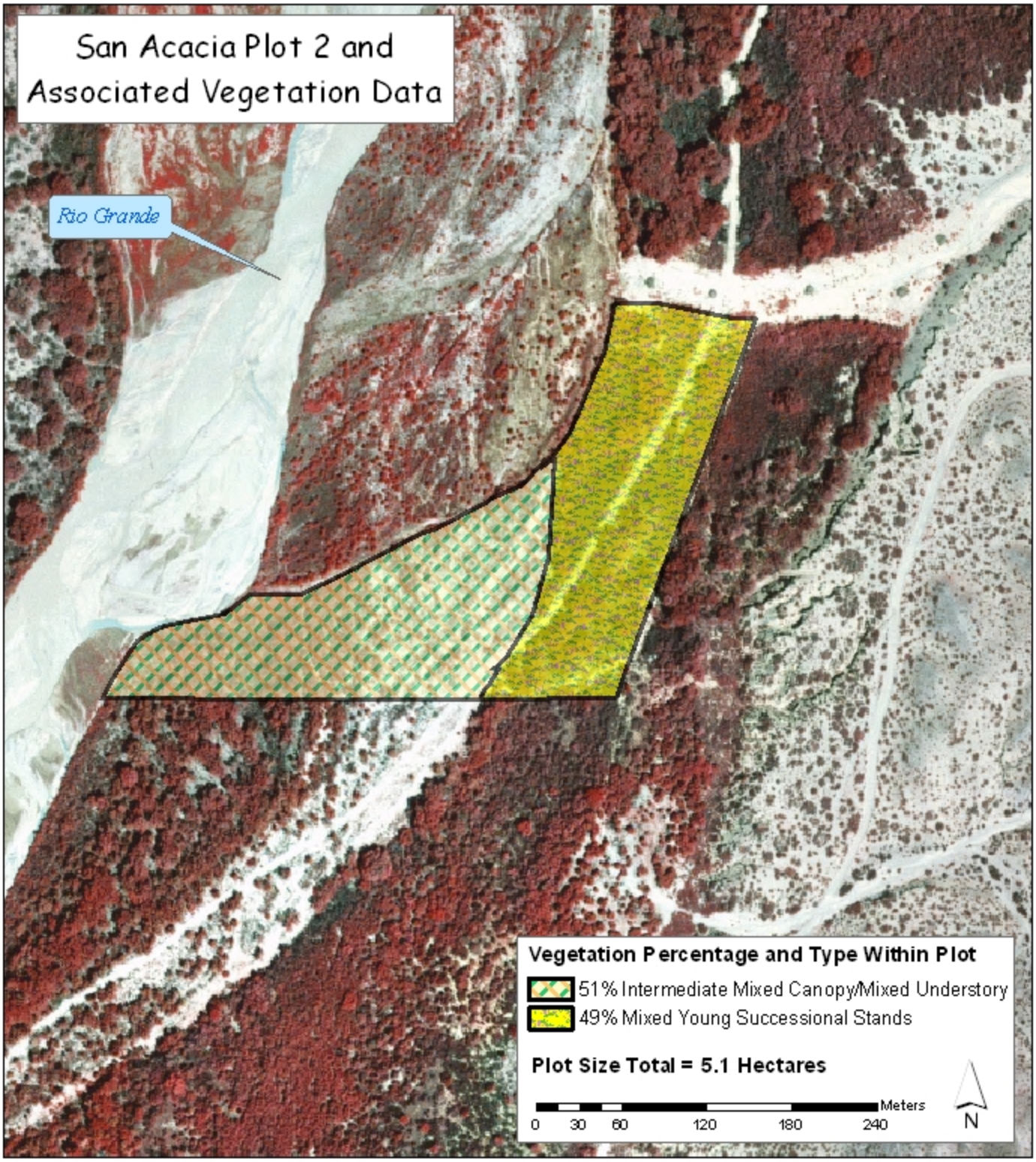
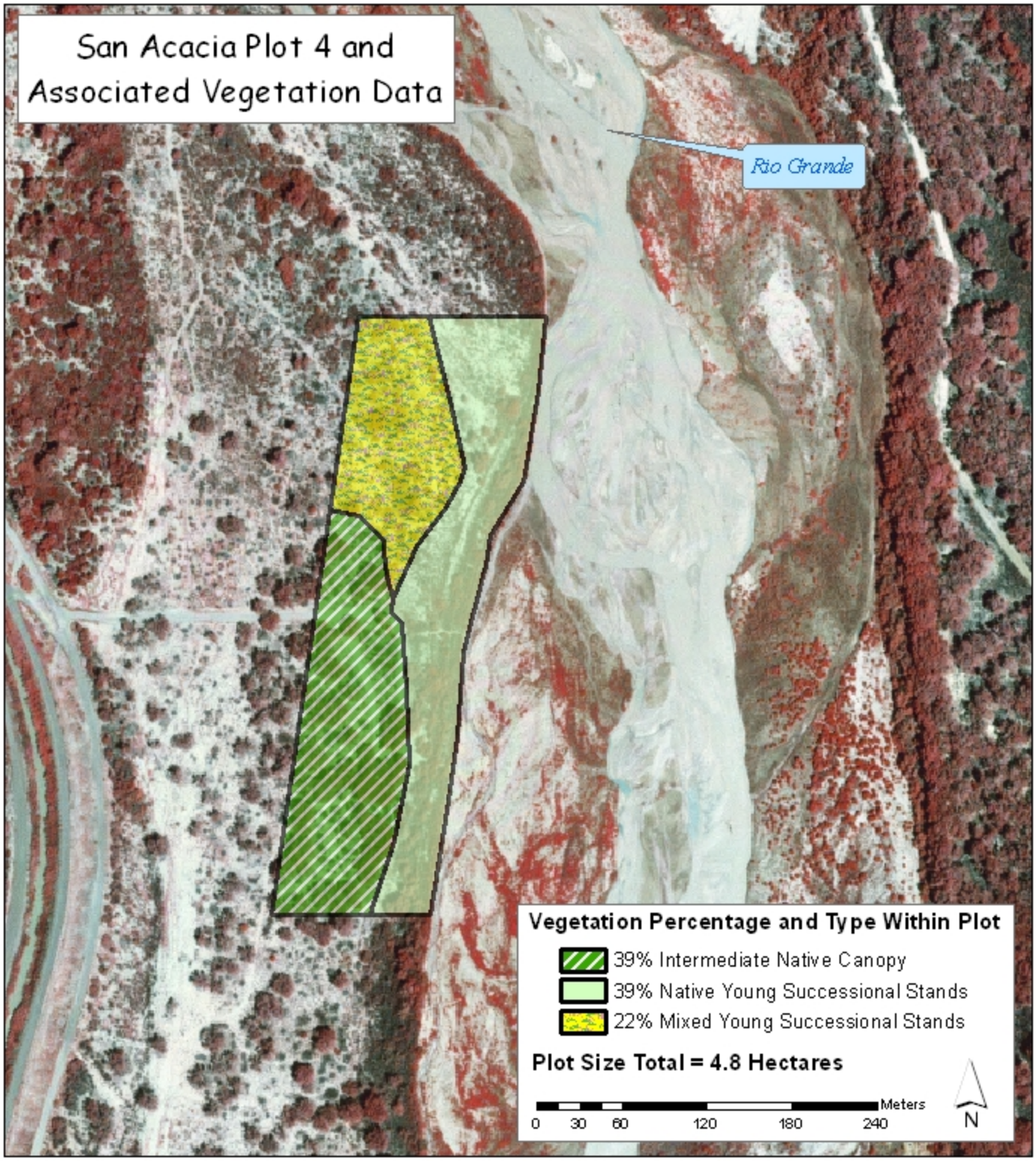
Appendix

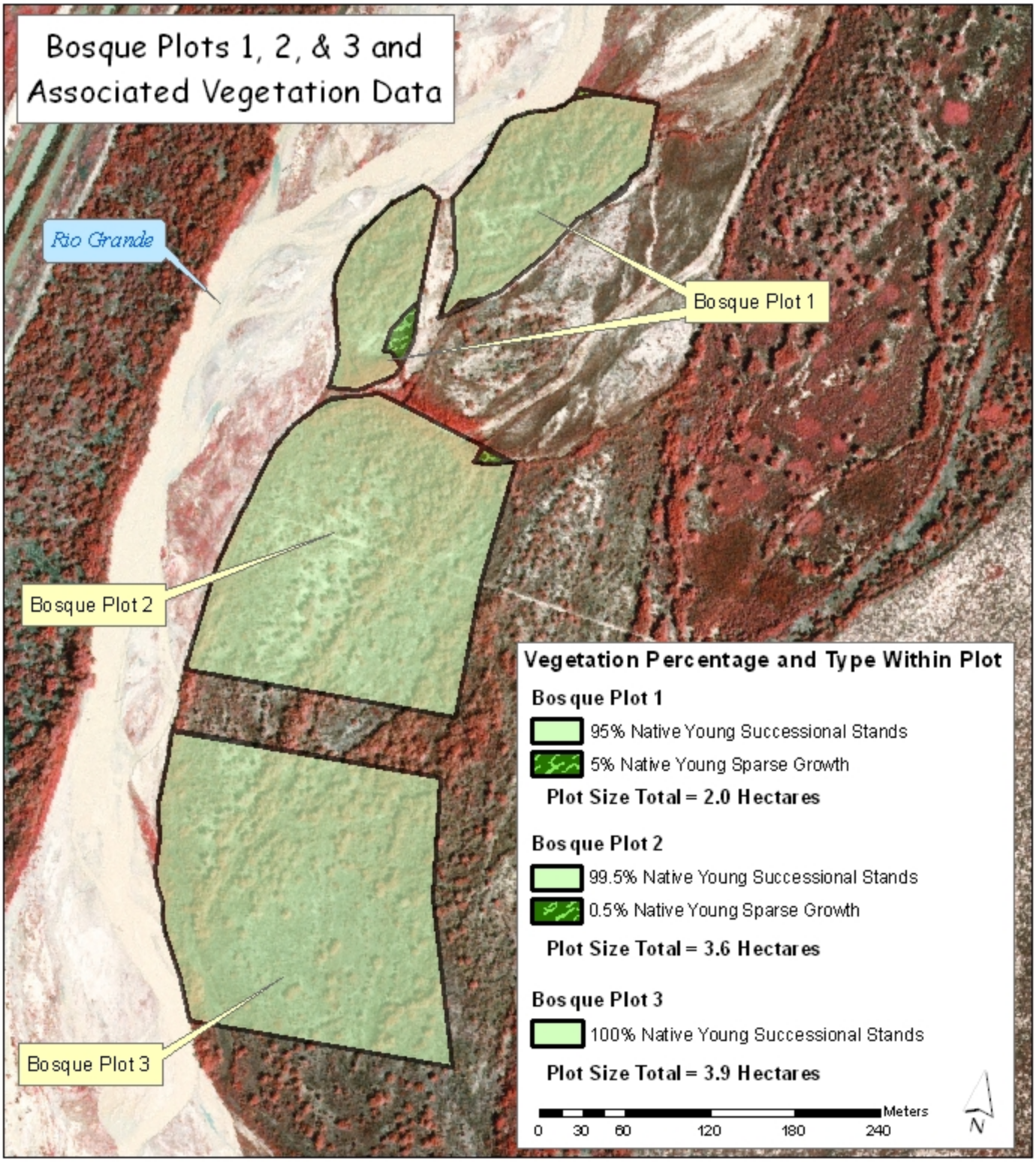
Maps of Nest Monitoring Plots

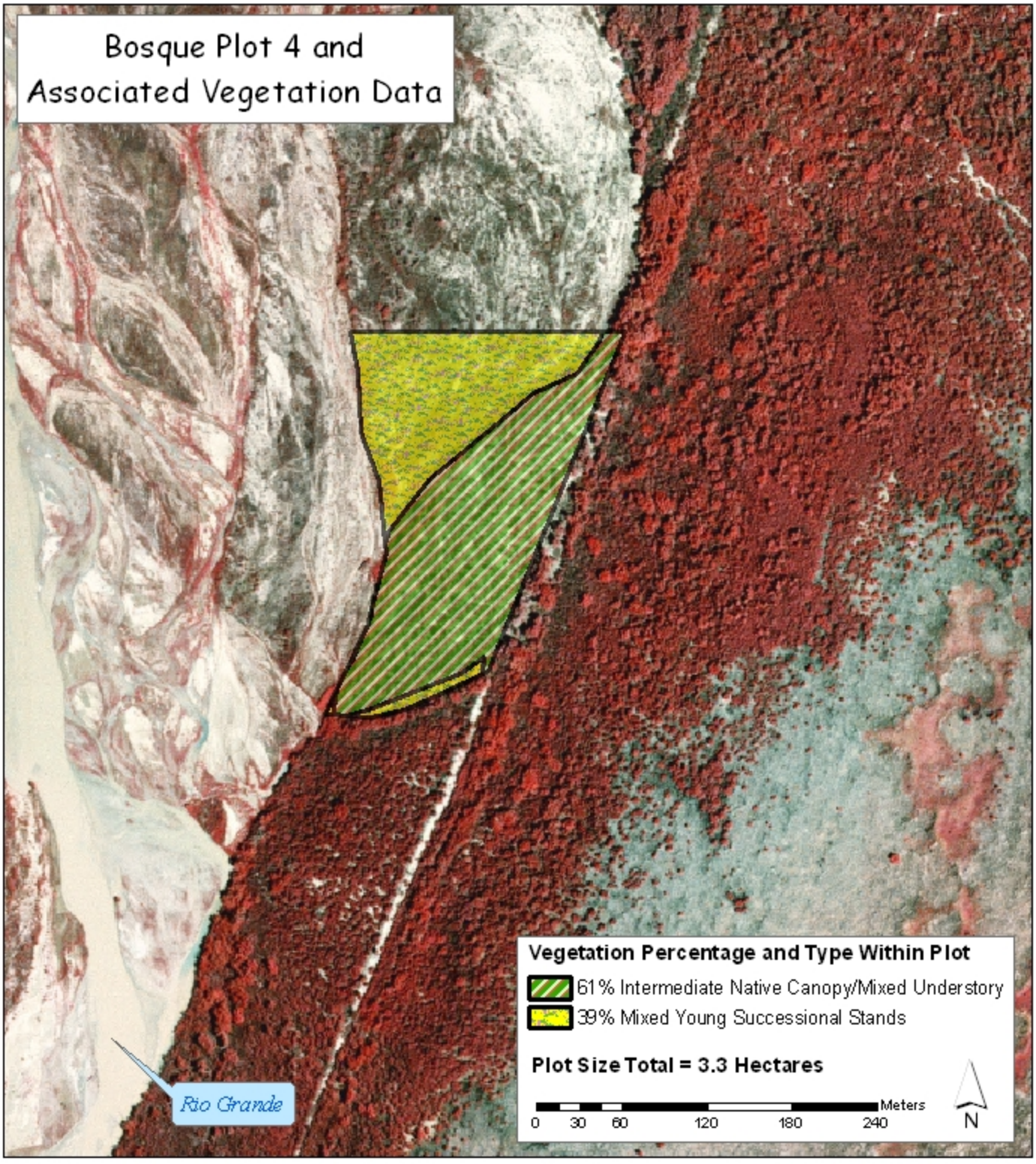

San Acacia Plot 1 and Associated Vegetation Data
Rio Grande
Vegetation Type and Percentage Within Plot
98% Native Young Successional Stands
2% Intermediate Native Canopy/Native Understory
Plot Size Total = 4.8 Hectares
Meters
0 30 60 120 180 240
N


San Acacia Plot 2 and
Associated Vegetation Data
Rio Grande
Vegetation Percentage and Type Within Plot
51% Intermediate Mixed Canopy/Mixed Understory
49% Mixed Young Successional Stands
Plot Size Total = 5.1 Hectares
Meters
0 30 60 120 180 240
N

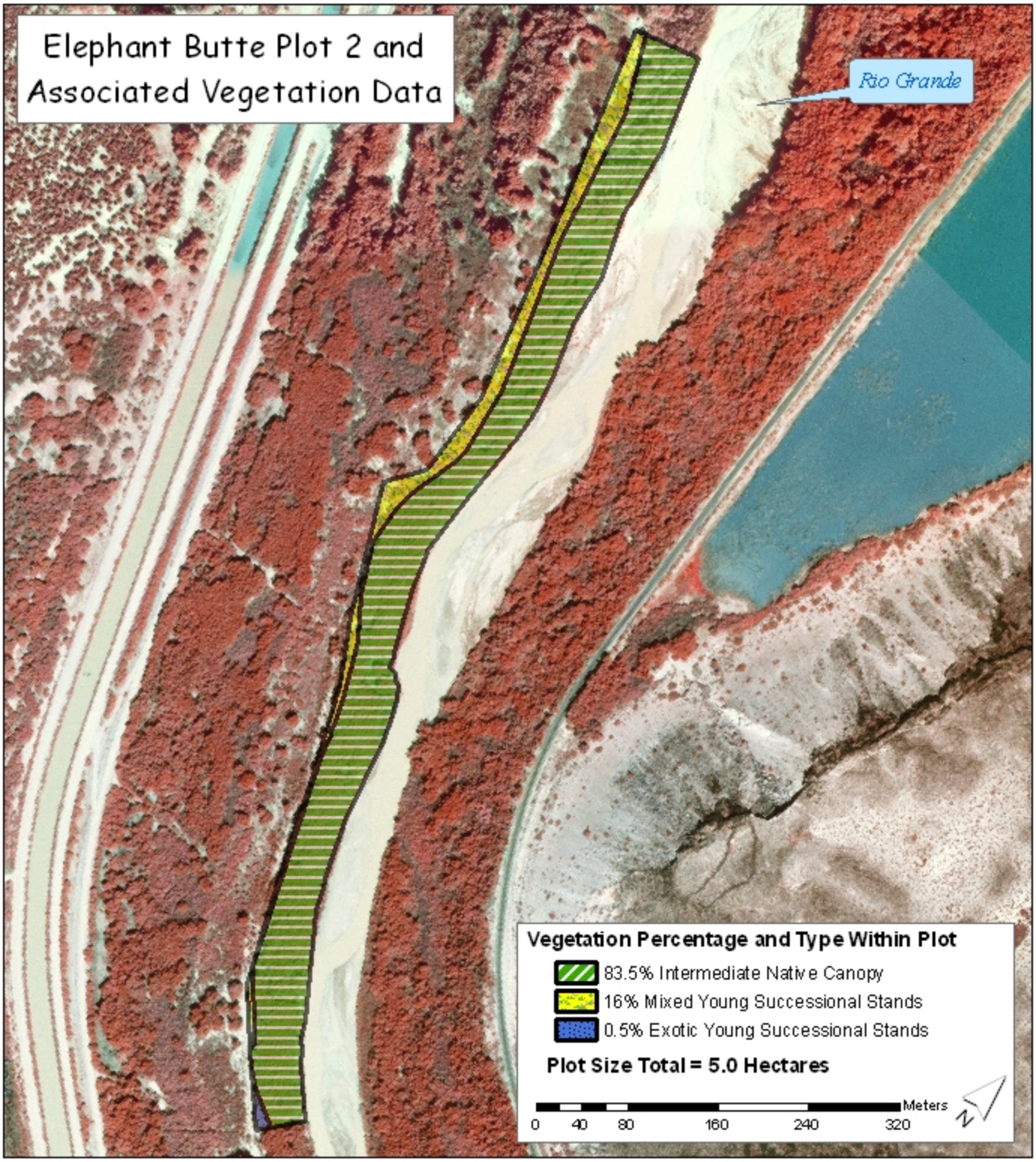

San Acacia Plot 3 and
Associated Vegetation Data
Rio Grande
Vegetation Percentage and Type Within Plot
100% Intermediate Mixed Canopy/Native Understory
Plot Size Total = 4.2 Hectares
Meters
0
30
60
120
180
240
N

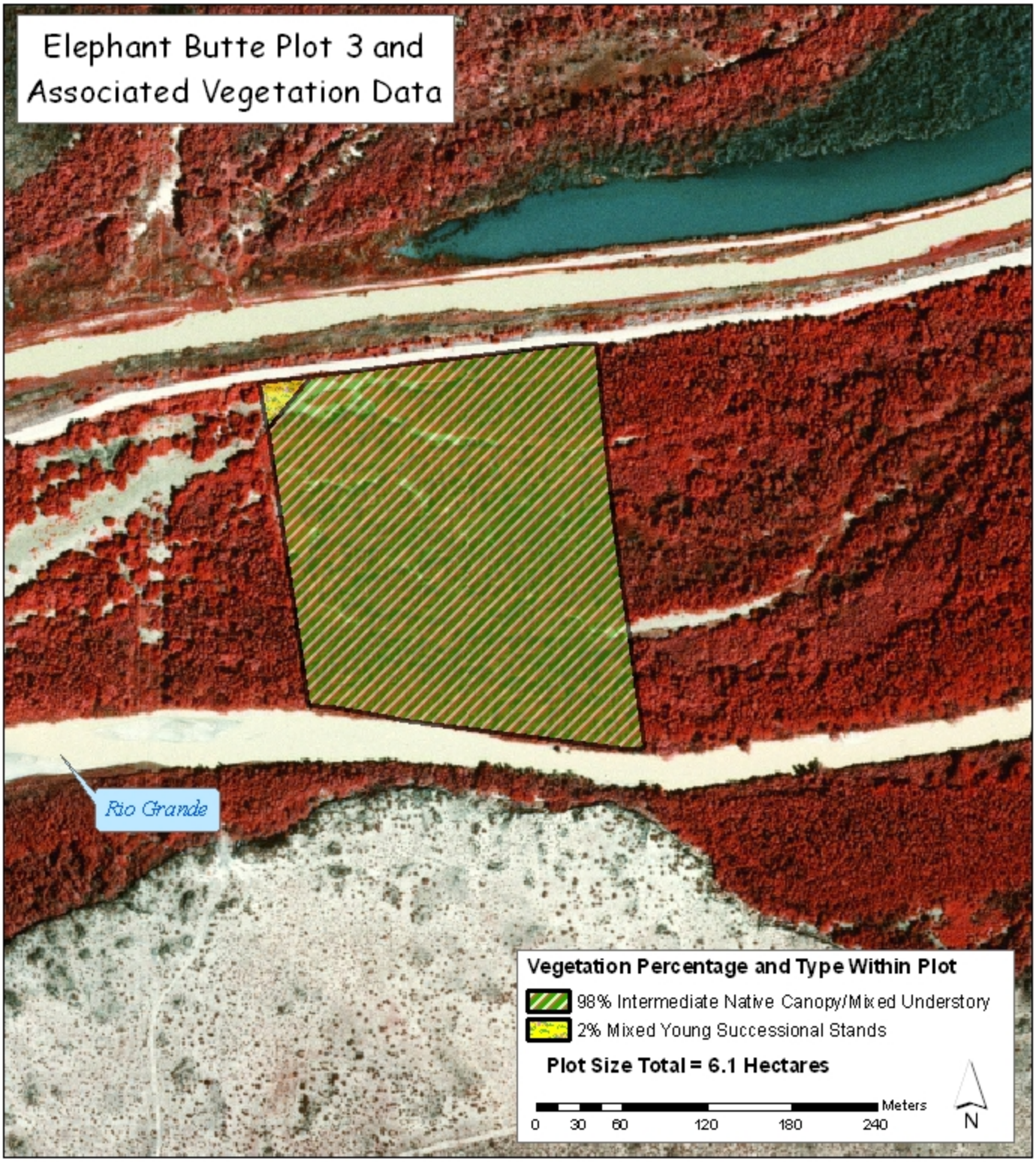

San Acacia Plot 4 and
Associated Vegetation Data
Rio Grande
Vegetation Percentage and Type Within Plot
39% Intermediate Native Canopy
39% Native Young Successional Stands
22% Mixed Young Successional Stands
Plot Size Total = 4.8 Hectares
Meters
0
30
60
120
180
240
N


Bosque Plots 1, 2, & 3 and Associated Vegetation Data
Rio Grande
Bosque Plot 1
Bosque Plot 2
Bosque Plot 3
Vegetation Percentage and Type Within Plot
Bosque Plot 1
95% Native Young Successional Stands
5% Native Young Sparse Growth
Plot Size Total = 2.0 Hectares
Bosque Plot 2
99.5% Native Young Successional Stands
0.5% Native Young Sparse Growth
Plot Size Total = 3.6 Hectares
Bosque Plot 3
100% Native Young Successional Stands
Plot Size Total = 3.9 Hectares
Meters
0 30 60 120 180 240
N


Bosque Plot 4 and
Associated Vegetation Data
Rio Grande
Vegetation Percentage and Type Within Plot
61% Intermediate Native Canopy/Mixed Understory
39% Mixed Young Successional Stands
Plot Size Total = 3.3 Hectares
Meters
0
30
60
120
180
240
N


Elephant Butte Plot 1 and Associated Vegetation Data
Rio Grande
Vegetation Percentage and Type Within Plot
100% Intermediate Native Canopy/Mixed Understory
Plot Size Total = 4.7 Hectares
Meters
0 30 60 120 180 240
N


Elephant Butte Plot 2 and Associated Vegetation Data
Rio Grande
Vegetation Percentage and Type Within Plot
83.5% Intermediate Native Canopy
16% Mixed Young Successional Stands
0.5% Exotic Young Successional Stands
Plot Size Total = 5.0 Hectares
Meters
0
40
80
160
240
320


Elephant Butte Plot 3 and Associated Vegetation Data
Rio Grande
Vegetation Percentage and Type Within Plot
98% Intermediate Native Canopy/Mixed Understory
2% Mixed Young Successional Stands
Plot Size Total = 6.1 Hectares
Meters
0 30 60 120 180 240
N


Elephant Butte Plot 4 and Associated Vegetation Data
Rio Grande
Vegetation Percentage and Type Within Plot
83% Intermediate Native Canopy/Mixed Understory
17% Native Young Successional Stands
Plot Size Total = 3.8 Hectares
Meters
0 25 50 100 150 200
N